What is momentum?

- velocity and time?
- how much something weighs?
- moving mass
- release of potential energy
- inertia
- negative acceleration v. kinetic energy
- object that moves has momentum
- having the drive to do something
- greater mass has greater momentum

Momentum:

- intrinsic property of objects

  base characteristic

- momentum = (mass)(velocity)

- $\bar{p} = m\bar{v}$

- We are concerned with a change in momentum:

$$\Delta\bar{p} = m\Delta\bar{v}$$

$$\bar{p}_f - \bar{p}_i = m(\bar{v}_f - \bar{v}_i)$$

Conservation of Momentum:

- Happens when two "objects" collide

$$\sum \bar{p}_i = \sum \bar{p}_f$$

↳ Sigma, means "sum of"

$$\bar{p}_{1i} + \bar{p}_{2i} + \ldots = \bar{p}_{1f} + \bar{p}_{2f} + \ldots$$

Collisions:

- Three types:
  - Perfectly elastic
    - never happens in real life
    - hit and bounce
    - all momentum and energy are conserved
  - Combination of inelastic and elastic
    - Almost all real-world types of collisions
  - Perfectly inelastic
    - hit and stick
    - two objects start apart and come together
    - two objects start together and move apart

Equations:

- Perfectly elastic:

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$\bar{p}_{1i} + \bar{p}_{2i} = \bar{p}_{1f} + \bar{p}_{2f}$$

- Perfectly inelastic:

$$(m_1 + m_2)\bar{v}_i = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1 + m_2)\bar{v}_f$$

- All three equations are for one-dimension

- Directions REALLY matter for these problems.